course of his presidential address, points out how entomologists may assist in elucidating many problems of biology. He rightly remarks that, "Without entering very far into the philosophical phase of his subject, every practical entomologist has it in his power to contribute something towards solving one or the other of the problems connected with variation, heredity, and the general laws operating in the production of species. He is already expert at rearing insects from the egg'; let him continue to do this, but let him conduct his rearing operations on experimental lines. . . . A useful course of experimental work would be to endeavour to develop some particular varietal tendency exhibited by a species."

The spring announcements of the Cambridge University Press include:—The Collected Mathematical Papers of the late Arthur Cayley, F.R.S., to be completed in thirteen volumes, vol. xii.; The Scientific Papers of John Couch Adams, F.R.S., vol. ii, edited by Dr. W. G. Adams and R. A. Sampson; The Foundations of Geometry, by the Hon. B. Russell; A Treatise on Abel's Theorem, by H. F. Baker; The Theory of Groups of a Finite Order, by W. Burnside, F.R.S.; A Treatise on Universal Algebra, with some applications, by A. N. Whitehead. Vol. i. contains the General Principles of Algebraic Symbolism: The Algebra of Symbolic Logic: The Calculus of Extension (*i.e.* the Algebra of Graffmann's Ausdehnungslehre), with applications to Projective Geometry, to Non-Euclidean Geometry, and to Mathematical Physics; A Treatise on Octonions: a development of Clifford's Bi-Quaternions, by Prof. Alexander McAulay; A Treatise on Spherical Astronomy, by Prof. Sir Robert S. Ball, F.R.S.; A Treatise on Geometrical Optics, by R. A. Herman; An Elementary Course of Infinitesimal Calculus, for the use of Students of Physics and Engineering, by Prof. Horace Lamb, F.R S.; Theoretical Mechanics: an introductory Treatise on the Principles of Dynamics, with numerous applications and examples, by A. E. H. Love, F.R.S.; The Works of Archimedes, edited in modern notation, with introductory chapters, by Dr. T. L. Heath; Handbook to the Geology of Cambridgeshire, by F. R. Cowper Reed. Cambridge Natural Science Manuals.—(Biological Series) Fossil Plants: a Manual for Students of Botany and Geology, by A. C. Seward; The Vertebrate Skeleton, by S. H. Reynolds; Vertebrate Palæontology, by A. S. Woodward; (Physical Series) Electricity and Magnetism, by R. T. Glazebrook, F.R.S.; Sound, by J. W. Capstick; (Cambridge Geographical Series) A History of Ancient Geography, by the Rev. H. F. Tozer, with ten maps.

The additions to the Zoological Society's Gardens during the past week include a Chacma Baboon (*Cynocephalus porcarius*, ♂), a Levaillant's Cynictis (*Cynictis penicillata*), a Black-backed Jackal (*Canis mesomelas*) from South Africa, presented by Mr. J. E. Matcham; a Cheetah (*Cynælurus jubatus*) from Africa, presented by Colonel W. H. Wylde; a White-bellied Pangolin (*Manis tricuspis*) from Lagos, presented by Mr. F. W. Marshall; an Alexandrine Parrakeet (*Palæornis alexandri*, ♂) from India, presented by Mrs. Randall; a Severe Macaw (*Ara severa*) from South America, presented by Mrs. J. Keser; three Indian Pigmy Geese (*Nettopus coromandelianus*, ♂ ♂ ♀) from India. presented by Mr. Frank Finn; a Tesselated Snake (*Tropidonotus tesselatus*) from South Europe, presented by Mr. W. R. Temple; a Natal Python (*Python sebæ*, var) from South Africa, presented by Mr. Luscombe Searelle; three Purplish Death-Adders (*Pseudechis porphyriacus*), a Shielded Death-Adder (*Notechis scutatus*), three Australian Banded Snakes (*Diemenia nuchalis*), an Occipital Elaps (*Furina occipitalis*) from Australia, deposited; a Maximilian's Aracari (*Pteroglossus wiedi*) from Brazil; two Rosy-faced Love-Birds (*Agapornis roseicollis*) from South Africa, purchased; two Collared Fruit Bats (*Cynonycteris collaris*), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

The Planet Mars.—Prof. Schiaparelli has just published an account of his observations of Mars made during the years 1883–84. These observations are contained in the publication of the *Reale Accademia dei Lincei*, 1895–96, and are accompanied by a new chart of the surface-markings and eight diagrams of the planet's disc. Of the thirty-one canals seen to develop in 1881 and 1882, only eighteen have been observed again at this opposition, while seven new ones have been noted. In the polar gap a large dark rift was seen, apparently separating the snow into two unequal portions. An examination of the chart with that published by Lowell will be found to give many interesting points of difference. In the March number of the *Bulletin de la Société Astronomique de France* there will be found a brief account of these observations, with reproductions of the plates in Schiaparelli's original memoir. There are added a series of drawings of the planet observations, made from the Observatory of Juvisy, at the opposition in December last.

Some interesting observations, made of Mars last year, are contributed to the current number of the *Astronomischen Nachrichten* (No. 3411). The observer, Herr Leo Brenner, saw altogether 126 canals, 31 of which were new, while 13 and 82 were Lowell's and Schiaparelli's respectively. He gives, in a table, the positions of these new canals, remarking that he never saw any of the canals doubled. Five new seas were seen by him at positions B = 162° and + 32°, C = 261° and + 36°, D = 270° and + 48°, E = 201° and + 27°, 4 = 215° and + 3°. The sea E had been previously seen by Antoniadi, who thought that it represented a doubling of Trivium. Propontis was seen doubled, the old one lying to the westward. On September 8 the last was seen of the south polar snow, and on the same date the north pole was distinctly observed. Nilosyrtis was bridged over as shown in Schiaparelli's map of the year 1882, but further to the south than is shown there. Several other points of interest were noted. A full account of these will be published in the *Kais. Akademie der Wissenschaft.*

In the same number of the *Astr. Nachr.*, mentioned above, M. V. Cerulli gives a brief account of his observations on Mars, made between October 1896 and January of this year.

Double-Star Measures.—The *Astronomical Journal* (No. 397) gives the measures of several observers of double-stars. Prof. W. J. Hussey contributes measures of eighty different doubles made with the 12-inch and 36-inch of the Lick Observatory. The Morrison Observatory adds several more, measured by Mr. Henry S. Pritchett with the 12½-inch of that observatory. Mr. W. S. Eichelberger, of the Wesleyan University Observatory, Middletown, also publishes a few measures, but does not state the size of the instrument employed. Several bright objects among the southern stars, which have hitherto been supposed to be single, have now been proved to be double, according to Prof. T. J. J. See (*Astr. Nach.*, No. 3312). Further, several wide pairs have been resolved into triple systems of high interest. Three special cases of the former are mentioned, and as they seem likely to be of interest to other observers, we give the following data:—

ψ *Velorum*, discovered 1897 January 31.
α = 9h. 26m. 46·6s. = – 40° 1′ 50″·5 (1900·0
1897·084. Pos. angle 258°·8. Dist. 0″·54.
Mag. 5 and 5·1. Both yellow.

p Velorum, discovered 1897 January 10.
α = 10h. 33m. 6·5s. ∂ = – 47° 42′ 3″·9.
1897·065. Pos. angle 268°·9. Dist. 0″·47.
Mag. 4·6 and 5·2. Both yellow.

λ *Lupi*, discovered 1897 February 1.
α = 15h. 2m. 7·2s. ∂ = – 44° 53′ 31″·5.
1897·085. Pos. angle 178°·6. Dist. 0″·30.
Mag. 4·9 and 5·2. Both yellow.

Belgium Observatory Annual.—The director of the Royal Belgium Observatory brings together in the annual for this year (the sixty-fourth year) a mass of useful information which will be serviceable to meteorologists as well as astronomers. In addition to the usual solar and planetary ephemerides, occultations, &c., Prof. F. Folie has written some short chapters on the following points:—A reaction in astronomy, accurate history of the discovery of diurnal nutation, explanations of the systematic differences between the Greenwich,

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Melbourne, and Cape catalogues by the diurnal nutation and the annual displacement of the pole of inertia, the probability of the existence of diurnal nutation from observations, Chandler's formulæ for computing the variations of latitude, planetary aberration, and the new method of reckoning time (one to twenty-four hours) on the railways. All that one can desire to know about the weather in Belgium during the past year will be found in the excellent summary given by the meteorological director of the observatory, M. A. Lancaster. Several interesting plates are given in his summary. Towards the end of the book various miscellaneous tables and yearly summaries will be found of general interest.

THE JAMES FORREST LECTURE—BACTERIOLOGY.

Dr. G. Sims Woodhead, Director of the Laboratories of the Conjoint Board of the Royal Colleges of Physicians and Surgeons, delivered the James Forrest Lecture before the Institution of Civil Engineers on March 18.

After a short introduction, the lecturer sketched briefly the history of bacteriology, and gave an account of Leeuwenhoek's observations, some of which were either directly or through his friends communicated to the Royal Society of London. The organisms described by Leeuwenhoek, in 1683, "were so small that they did not appear larger than represented at E (giving a copy of the figure). The motion of these little creatures, one among another, may be imagined like that of a great number of gnats or flies sporting in the air. From the appearance of these, to me, I judged that I saw some thousands of them in a portion of liquid no larger than a grain of sand, and this liquid consisted of eight parts water, and one part only of the before-mentioned substance taken from the teeth." Leeuwenhoek's microscopes magnified from 40 to 160 times. At that time he had not made up his mind as to the exact nature of these organisms; he spoke of them as living animalculæ, but in some of them he was unable to detect the slightest movement or any sign of life, nor did he theorise as to the meaning of the presence of these organisms in the situation in which he found them, though later, in 1713, he appeared to be under the impression that the organisms seen in the teeth were conveyed into the mouth by drinking-water that had been stored in barrels.

The various forms of bacteria were then briefly described, their size, structure, and mode of growth. Alterations in form were noted, and the marked differences, not only in minute structure, but in mode of growth, and in the nature of their products were indicated. The modifications in the sheath or covering of these organisms were demonstrated, and the frog, spawn, or living glue masses were explained. Fine flagella were shown in organisms that differed very widely as to their nature and functions, and it was pointed out that, from what we know, however, of other flagella and cilia, and from recent observations on the arrangement of the pores in the membrane, and the relation of the flagella to these pores, it is to be anticipated that they are usually, at any rate, processes directly continuous with the central protoplasm of the organism. At one time it was supposed that these flagella were formed only in organisms that have a special affinity for oxygen; but within the last couple of years it has been pointed out that the tetanus bacillus, the organism which grows best where free oxygen is excluded, often presents beautiful flagellated forms, although—and this is an important fact—the organism, as pointed out by Kanthack, remains non-motile when examined under the microscope in the presence of oxygen. How it behaves when oxygen is excluded, has not yet been determined. Even those which have an affinity for oxygen appear to lose their flagella as soon as they leave the surface, and no longer require to move about in order to obtain this substance.

Spore formation was fully described, and the great resistance that these "seed" spores present to heat and chemicals was noted. As an example of the importance of this spore formation, what takes place in the case of the splenic fever bacillus that is found in cattle was mentioned. When an ox dies of anthrax there are found in its blood an enormous number of short thick rods, the anthrax bacilli. If a drop of the blood be taken from a blood-vessel immediately after the death of the animal, the rods will be found, on microscopic examination, to contain no spores—that is, there are no bright points in the substance of the rod, and the animal, if buried at once before any blood or discharges from the body can get on to the land where the animal has died, will not be a source of infection; the putrefactive organisms that develop being sufficient to kill off the anthrax bacilli that are in the blood. If, however, the animal be cut into, and blood be allowed to escape so that the organisms come into contact with the air, and the condition of the blood is altered in such a way that the nutritive supply of these organisms is gradually cut off, spores immediately begin to develop in the bacilli, and, as soon as this takes place, it is an exceedingly difficult matter to get rid of the disease; mere burial is certainly not sufficient, as the spores are not affected by the putrefactive organisms and products—they retain their vitality, and only wait for more favourable conditions under which to become again developed into the active and virulent anthrax organism. The knowledge of this fact, of course, has a most important bearing on the treatment of carcases of animals that have succumbed to anthrax. Other forms of spores of a less resistent character have been described; but it is scarcely necessary to do more than mention them, as they are not yet accurately understood.

As to the effects of temperature upon micro-organisms, it has been found that most of the saprophytes (those that grow upon dead matter) flourish most luxuriantly at the ordinary temperature of water, whilst the parasite or disease-producing bacteria grow and multiply most rapidly at the temperature of their animal or plant hosts. Most of these are killed at a temperature of 60° C. (140° F.). Certain bacteria, however, especially those found in soil and river mud, develop readily at 60° or 70° C., and flourish most luxuriantly at 50° C. C. Globig, and also, quite recently, A. Macfadyen, have shown that there are numerous organisms which can exist at temperatures even higher than this, in spite of the fact that they contain no spores. Of the spore-bearing organisms Dr. Woodhead showed the tetanus and anthrax bacilli, both of which are pathogenic or disease-producing, and the bacillus subtilis or hay bacillus, which is found especially in hay infusions, and appears to be associated with the reduction of organic matter in the process of putrefaction.

The production of enzymes, of acids, and of gases was described to indicate what different functions these organisms may have; and the different ways in which the aerobes and anaerobes are able to take the elements they require for their nutrition, and for the carrying on of their special functions, were explained, and the importance of these processes in the transformation and breaking down of dead organic matter insisted upon. In nature the process of disintegration of such matter is divided essentially into three parts. It is necessary (1) to get all solid matter into solution; (2) to supply as large a quantity of oxygen in as short a time as possible to this organic matter; (3) to attack the organic matter in solution by means of micro-organisms, and to so break it up that the various elements of which this complex material is composed may be thrown into an unstable or nascent condition so that the oxygen present may have an opportunity of entering into combination, and of forming what are called oxidised substances. It is evident from what we know of putrefactive processes that these changes may take place in two perfectly different ways. In the one case we have the oxidation taking place directly, all the nascent substances being satisfied by the oxygen of the air, and the splitting up of the organic matter being carried on by aerobic organisms. In such a process of oxidation which takes place in porous soil well supplied with air and moisture, and also in water which is from time to time well saturated with oxygen, it will be found that little or no putrefactive odour is developed. The marsh gas, the sulphuretted hydrogen, and other similar substances as they are set free, rapidly combine with oxygen to form sulphuric acid, carbonic acid and water; the nitrogenous substances in a similar fashion combining to form nitrous and nitric acids. In the soil these acids combine with the various basic substances, lime, magnesia and the like, so that they are rapidly removed and the way is left clear for the formation of fresh batches of the same substances. In anaerobic putrefaction, on the other hand, the process does not go on in this unobtrusive fashion, the anaerobic organisms having, as it were, to wrest their oxygen from the organic molecules because there is no free oxygen present, set up a much greater disturbance, and the products of the decomposition, such as sulphuretted hydrogen, marsh gas and ammonia, are thrown off in an unoxidised condition, and in the free form (*i.e.* no longer in a nascent condition), they remain comparatively stable, and give rise to the odours so characteristic of rapid anaerobic putrefaction.

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